Muon Trigger and Cosmic Ray Veto: LArIAT Phase I

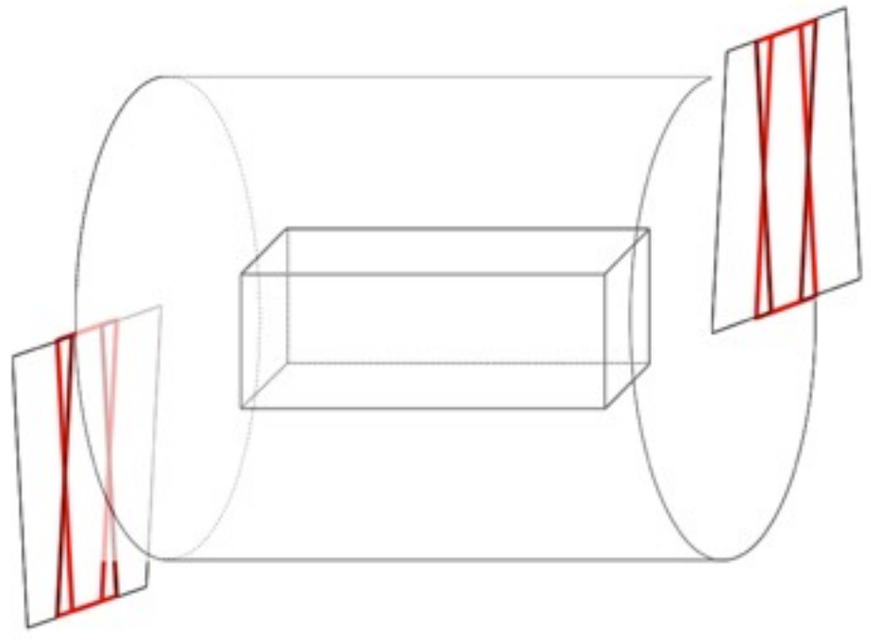
Jesus Rendon, Ryan Linehan, Roberto Acciarri, Andrew Olivier, Jieun Yoo, Emily Dvorak, Michelle Stancari, Renee Gardner

Overview

- Purpose
- TSU Scintillation Counter Tests
- Muon Trigger and Cosmic Ray Veto Configuration Optimization

Purpose

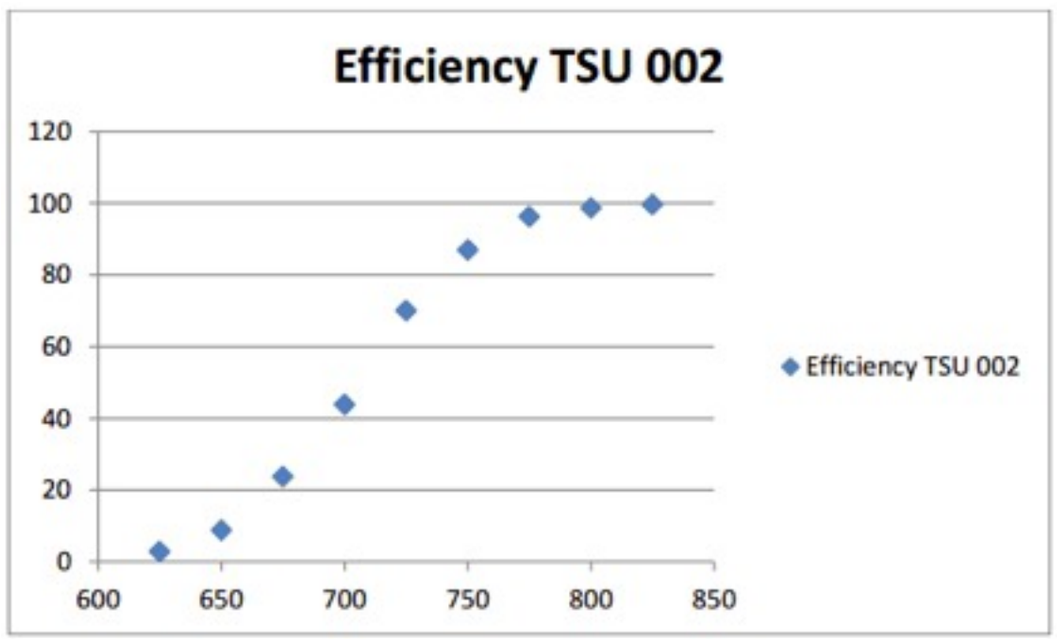
- We are using a muon trigger configuration to monitor liquid argon purity in the TPC
- Need to protect trigger from cosmic showers
  - Utilize veto system to select real events, rule out impostors



Schematic of TPC, cryostat, trigger system (in red) and one of the veto systems tested.

TSU Scintillators

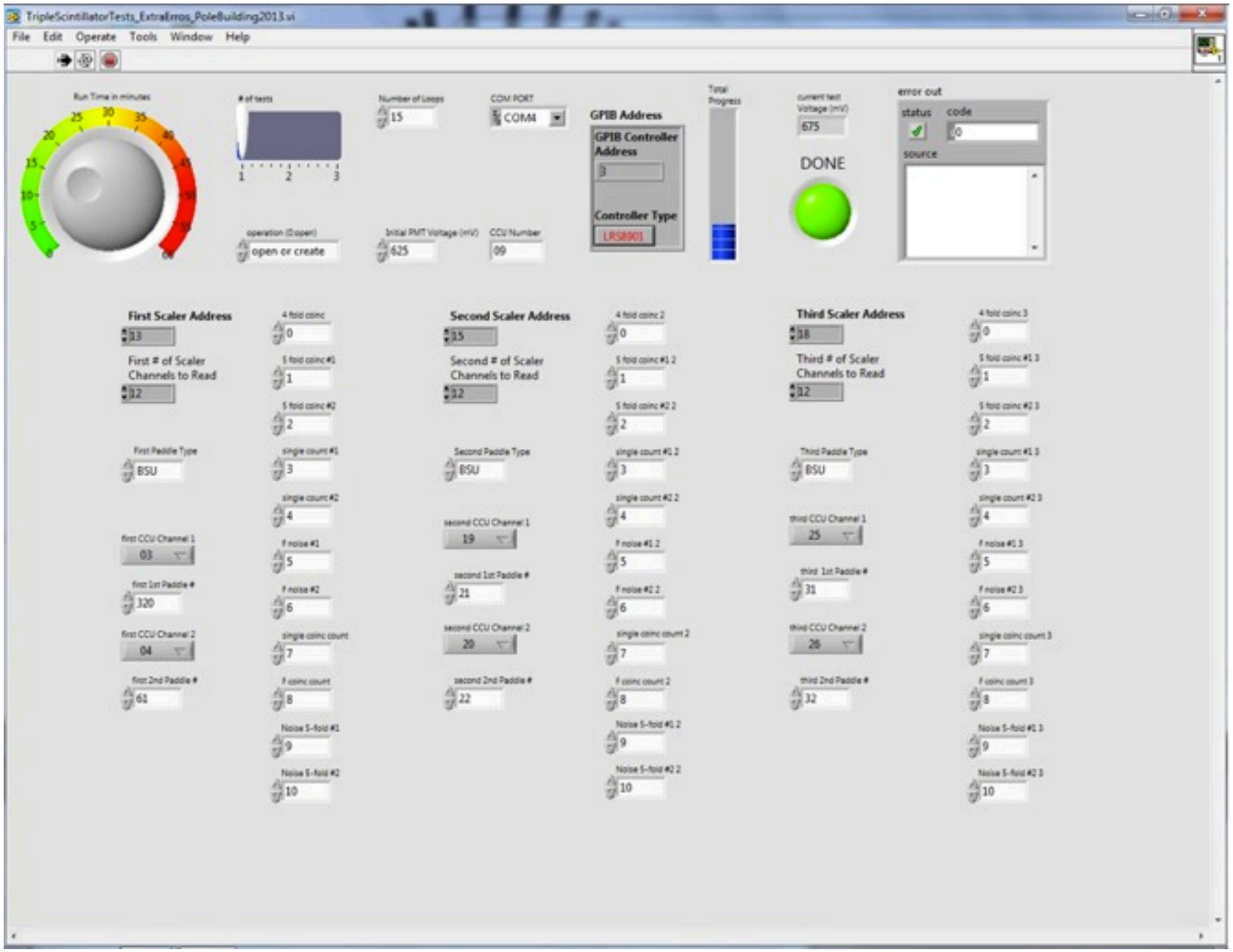
TSU Test Stand



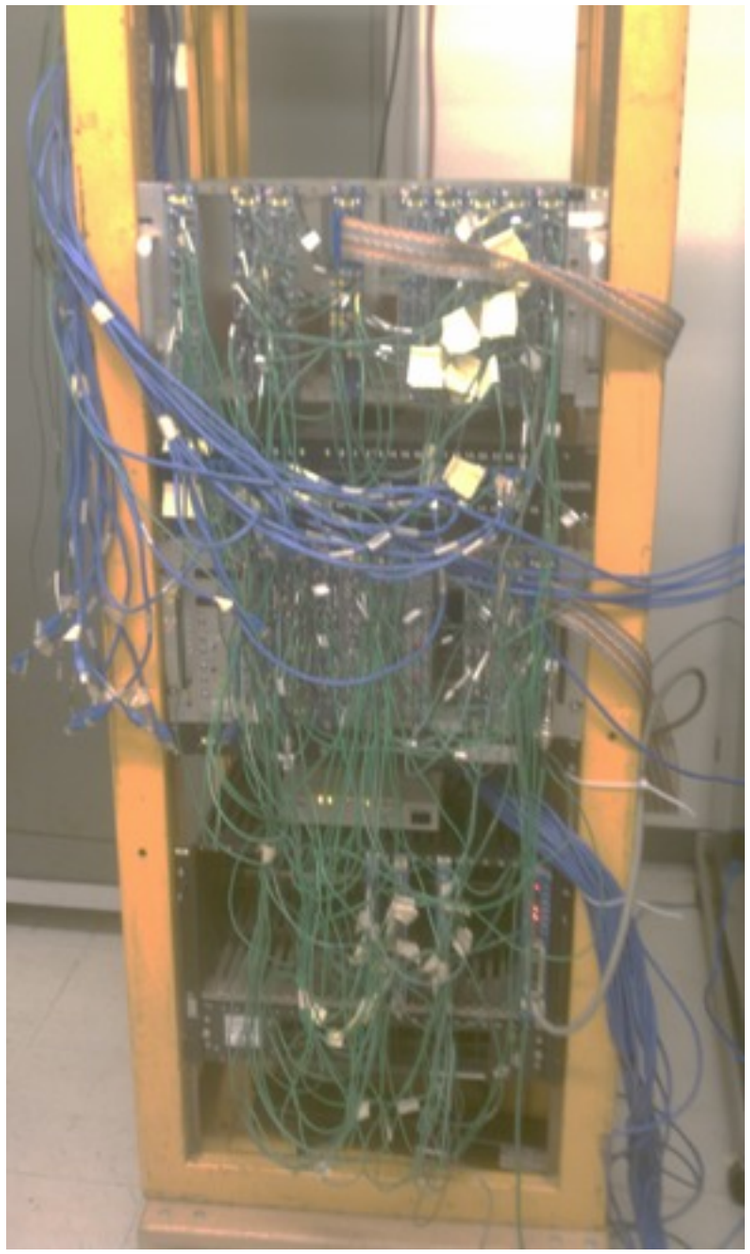
Sample TSU Efficiency Plot

- Tested efficiency, noise, operating voltage, single count rates for ~80 counters
- Light leak tests
  - Voltage/output connectors are main source of light leaks
- Trigger/Veto Counter Selection Standards
  - Efficiency (≥99%)
  - Lowest possible operating voltage for high efficiency
  - Low single count rate (<200 Hz)
  - Light leak testing

LabView Interface (Thanks, Emily!)

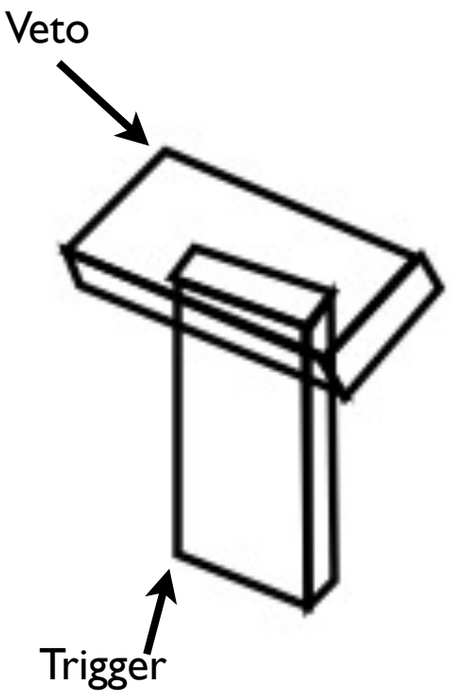


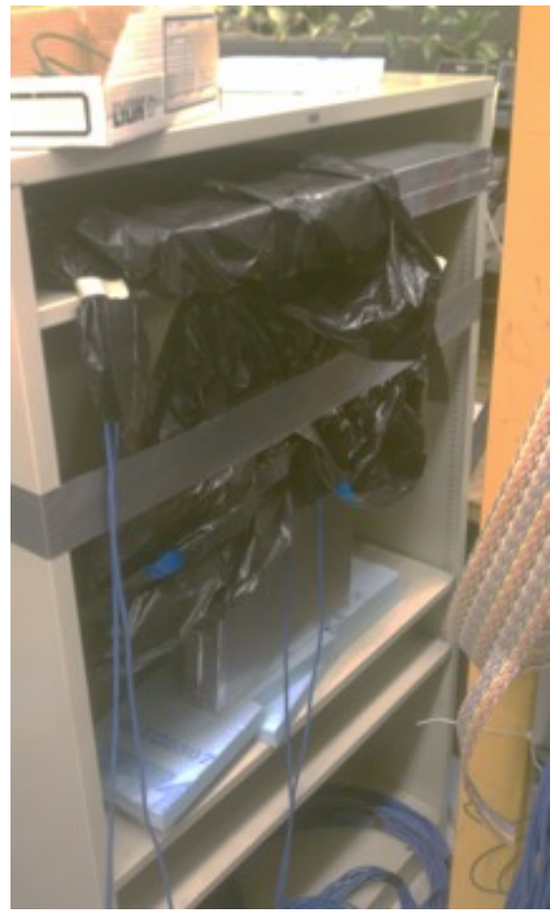
Electronics Rack



Trigger/Veto Configurations

- We simulated a TPC by 4 TSU counters placed in between the triggers
- We searched for a veto configuration that would allow us to maximize the ratio: $\frac{R_{trigger+TPC}}{R_{trigger}}$
- Logic "or" between each pair of counters in the veto configuration

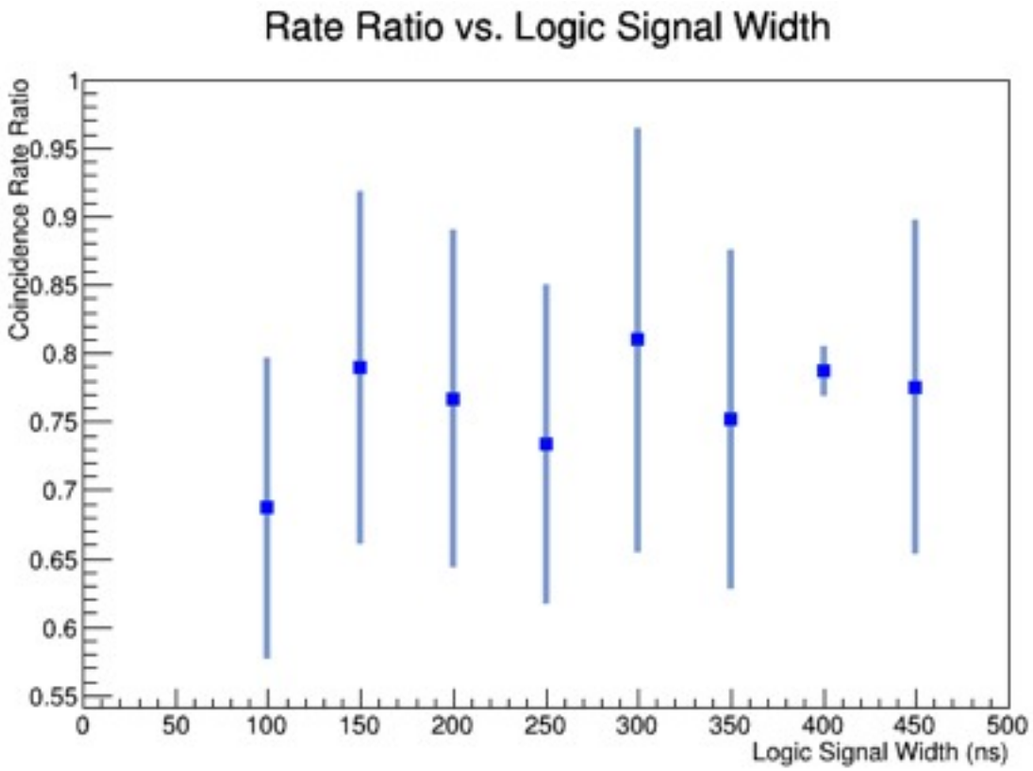


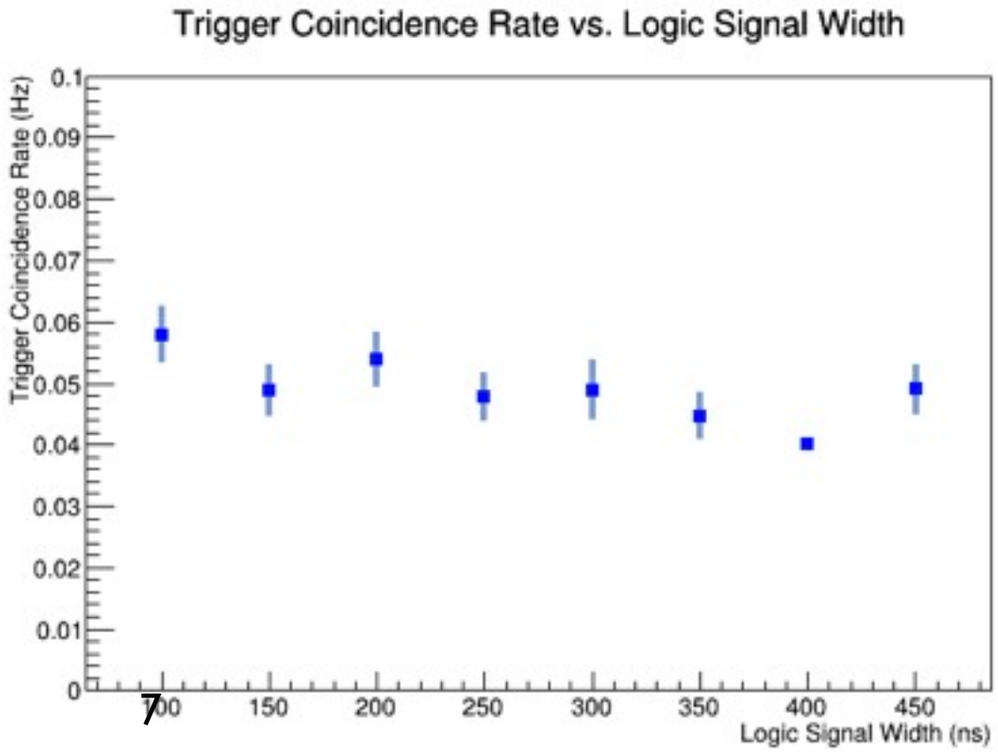


Optimal Trigger/Veto Configuration

Trigger/Veto Configs, cont.

- Once we found the best configuration, we attempted to optimize the width of the output logic signals
- In general, the coincidence rate ratio and trigger coincidence rate both stayed constant.
- We decided to choose a 400 ns logic signal width
- Resulting Ratio: 0.79
- Ends Only Rate: 0.04 Hz
- Ends and "TPC" Rate: 0.032 Hz





LArIAT Phase II

BSU Counter Testing

- BSUs are for a LArIAT Phase II muon telescope
- Tested 61 counters, found 43 good ones
- Criteria for "good":
  - Operating voltage selection: 50 mV above "plateau edge"
  - ≥95% efficiency at this voltage
  - <400Hz single count rate at this voltage
- Average efficiency: 99.1%
- Average single count rate: 210 Hz.